

Critical species of Odonata in western Africa

Klaas-Douwe B. Dijkstra¹ & Graham S. Vick²

¹ Gortestraat 11, 2311 MS Leiden, The Netherlands. <dijkstra@naturalis.nnm.nl>

² Crossfields, Little London, Tadley, UK. <camdragonfly@aol.com>

Key words: Odonata, dragonfly, IUCN, critical species, conservation, western Africa.

ABSTRACT

Western Africa – defined as the tropical area from Cameroon westwards – probably has the richest odonate fauna in Africa, particularly the region of (and around) the Cameroon highlands. This region is home to many relict and endemic species, such as the continent's only representatives of the families Amphipterygidae and Perilestidae. Previous selections of threatened West African Odonata have been arbitrary because it is impossible to differentiate between species that are genuinely endangered and those which are simply data-deficient. Many listed species just appear to be difficult to record or have been taxonomically confused; some 'endangered species' have already dissolved into synonymy. A revised and probably more complete selection of species requiring attention is provided, but because the source data is so scanty it remains subjective. Species in Gomphidae and Corduliidae are not included, as the knowledge of their taxonomy and distribution is particularly problematic at present. Many listed species may prove to be of minor concern once more research in the field and in the museum has been done. It is argued that if rainforest reserves (existing in most nations discussed) are maintained, the great majority of West Africa's unique Odonata will be protected. Although most rare species are probably stenotopic rainforest inhabitants, open landscapes also harbour a rich and potentially endangered odonate fauna.

INTRODUCTION

Western Africa is here defined as the tropical part of the continent from Cameroon westwards. To the east lies the forested heart of Central Africa, dominated by the Congo Basin, one of the least explored and potentially most interesting parts of the continent. The core of western and Central Africa is the Guineo-Congolian rainforest. In western Africa the rainforest forms an almost continuous belt along the coast. The highlands of Cameroon form the only large area of montane habitat in this part of Africa. The upland chain which runs into the Gulf of Guinea, and includes the islands of the Gulf, cuts through very wet lowland rainforest. This combination, and its assumed stability over time in a climatically changeable continent, may explain the great richness of the region, probably harbouring more

plant and animal species, endemics and relicts than any other part of Africa. From south to north the equatorial forest belt grades into wooded savannah, through the bush- and grasslands of the Sahel to the deserts of the Sahara, the boundary that severs the African tropics from the rest of the world. In Benin and Togo the savannah belt reaches the coast. This interval, known as the Dahomey Gap, separates the Upper Guinean forest (Ghana to Sierra Leone) from the Lower Guinean block (Nigeria eastwards). The richest part of the western block in terms of diversity and endemism lies in and around Liberia. Here are also some smaller highlands, of which Mount Nimba is most notable (White 1983; Kingdon 1989).

The knowledge of the Odonata of western Africa is relatively poor compared with that of eastern and southern Africa, where Elliot Pinhey was most active. Notable recent publications deal with the Odonata of The Gambia (Gambles et al. 1998; Prendergast 1998), Sierra Leone (Carfi & D'Andrea 1994), Liberia (Lempert 1988), Guinea (Legrand 1983; Legrand & Girard 1992; Legrand 2003), Côte d'Ivoire (Legrand 1982; Legrand & Couturier 1985), Ghana (O'Neill & Paulson 2001), Nigeria (Gambles 1980), SW Cameroon (Vick 1999) and Bioko (Brooks & Jackson 2001). There are numerous taxonomic difficulties with Afrotropical Odonata (Dijkstra 2003b). Because of the regional bias in Pinhey's work, and also due to the relative diversity of the fauna of this area, these problems are probably greatest in this part of the continent. Knowledge of the ecology and distribution of the species is even more fragmentary.

Table 1. Western and Central African Odonata species mentioned by Moore (1997) and the reasons for inclusion in his report. T: taxonomically isolated species, M: monotypic genera confined to one country, B: unusual biology, R: listed in the 2003 Red List of threatened species (IUCN 2003). CR: critical endangered; DD: data deficient; EN: endangered.

Family/species	T	M	B	R	Known distribution and habitat, updated
Amphipterygidae					
<i>Pentaplebia gamblesi</i> Parr, 1977	●	○	○	○	Mountain forest streams Obudu, Nigeria
<i>stahli</i> Förster, 1909	●	○	○	○	Mountain forest streams Cameroon and Nigeria
Perilestidae					
<i>Nubiolestes diotima</i> (Schmidt, 1943)	○	●	○	○	Mountain forest streams Cameroon
Coenagrionidae					
<i>Argiagrion leoninum</i> Selys, 1876	○	●	○	EN	Sierra Leone (possibly a mis-labelling)
<i>Argiocnemis umbargae</i> Pinhey, 1970	○	○	○	EN	Cameroon (possibly a known <i>Ceriagrion</i>)
<i>Enallagma camerunense</i> Karsch, 1899	○	○	○	EN	Actually a <i>Pseudagrion</i> , listed as such in the 2003 Red List, common in open habitats from The Gambia to Cameroon
<i>Pseudagrion quadrioculatum</i> Pinhey, 1964	○	○	○	DD	Bambesa, Congo-Kinshasa (probably a synonym of <i>P. superbum</i> Fraser, 1956)
Gomphidae					
<i>Cornigomphus guineensis</i> Martin, 1907	○	●	○	EN	Equatorial Guinea

Family/species	T	M	B	R	Known distribution and habitat (updated)
Corduliidae					
<i>Idomacromia lieftincki</i> Legrand, 1984	●	○	○	○	Forest streams Senegal to Gabon
<i>proavita</i> Karsch, 1896	●	○	●	○	Forest seepage, springs and streams Guinea to Congo-Kinshasa
<i>Neophya rutherfordi</i> Selys, 1881	●	○	○	○	Forest streams and rivers Sierra Leone to Congo-Kinshasa
Libellulidae					
<i>Aethiothemis watulikii</i> Pinhey, 1962	○	○	○	DD	Mambili Forest, Congo-Brazzaville (possibly a synonym of <i>Aethiothemis basilewskyi</i> Fraser, 1954)
<i>Allorrhizucha campioni</i> Ris, 1915	○	○	○	EN	Small rainforest rivers Sierra Leone and Liberia
<i>Anectothemis apicalis</i> Fraser, 1954	○	●	○	DD	Congo-Kinshasa (possibly a known <i>Congothemis</i>)
<i>Brachythemis liberiensis</i> Fraser, 1949	○	○	○	CR	Synonym of pan-African <i>Parazyxomma</i> <i>flavicans</i> (Martin, 1908)
<i>Congothemis longistyla</i> Fraser, 1953	○	○	○	DD	Congo-Kinshasa
<i>Palpopleura albifrons</i> Legrand, 1979	○	○	○	CR	Rainforest Gabon
<i>Trithemis hartwigi</i> Pinhey, 1970	○	○	○	EN	Marsh and montane lake, Bioko and Cameroon
<i>nigra</i> Longfield, 1936	○	○	○	CR	Principe
<i>Zygonychidium gracile</i> Lindley, 1970	○	●	○	○	Large savannah river (Bandama) near Korhogo, Côte d'Ivoire

CRITICAL SPECIES

Notes on species previously listed by IUCN

Table 1 gives the species listed by Moore (1997) and in the global Red List (IUCN 2003). The majority of these have not been recorded since their description. This can be for various reasons:

(1) Their taxonomic status is confused (see Dijkstra 2003b).

Argiagrion leoninum, known only from the unusual type female, may be a wrongly labelled specimen from another part of the world. *Enallagma camerunense* and *Brachythemis liberiensis* were found to be synonymous with the widespread *Pseudagrion angelicum* and *Parazyxomma flavicans* respectively (Dijkstra 2002, 2003a). Similarly *Argiocnemis umbargae*, *Pseudagrion quadrioculatum*, *Aethiothemis watulikii* and *Anectothemis apicalis* are more likely to be taxonomic misinterpretations than rarities: probable synonyms that have lingered in species lists partly because their generic placement was incorrect (K.-D.B. Dijkstra and V. Clausnitzer unpubl.) Another example of such an obscure taxon is *Cornigomphus guineensis*, which is possibly related to African *Onychogomphus* (Carle 1986), a group requiring revision urgently. Ultimately all these species can probably be removed from the current Red List.

(2) They are difficult to collect.

This seems particularly true for the listed corduliids. Both *Idomacromia* and *Neophya* have been recorded scattered across Equatorial Africa. They are probably more easily found as larvae than as adults (Legrand 1976, 1984, 1996).

The record of *Idomacromia lieftincki* from South-East Senegal (Legrand & Couturier 1985) suggests that the genus can be found well outside the rainforest belt. Central African species have been difficult to collect for a very different reason: political instability has restricted access to this region, especially Congo-Kinshasa.

(3) They are genuinely rare.

We feel, based on the limited sampling of Odonata in western Africa that occurs, that one is unable to say if there are species that fall into this category. There are species though, that appear to be confined to very small ranges and that may be vulnerable for that reason. The following can be said about the species which have been rediscovered: *Pentaphlebia stabli* and *Nubiolestes diotima* belong to a set of relict species occurring in the Cameroon highlands, which also includes *Neurolestes trinervis* and *Stenocnemis pachystigma*. They appear to be locally common in the mountain range which extends from Mount Cameroon towards Mamfe and the Cross River, and strong populations have been documented especially at Mount Kupe and the Bakossi Mountains in protected areas.

Trithemis hartwigi, formerly known only from Bioko, has been found on the Cameroon mainland opposite the island in marshes adjacent to Mount Cameroon (Vick 1999) and also at Lakes Beme and Muambong (G.S. Vick unpubl.), montane lakes in the Bakossi Mountains; but very few specimens are known from each site. *Allorrhizucha campioni* was found by Lempert (1988) on several small rivers in Liberia and is not thought to be threatened there by this author.

Species to be considered

The main criticism of the list of Moore (1997) is that the selection is haphazard, being based on the equally arbitrary selection of Pinhey (1982). For those species that are listed, it is impossible to know their true status, and the differentiation between 'endangered' and 'data deficient' species in the current list seems hard to justify. *Pentaphlebia gamblesi* and *Zygonychidium gracile* are mentioned by Moore (1997) for their uniqueness, but were not included in the Red List, despite remaining unrecorded since their description. There are numerous additional species that appear to be rare and deserve to be listed as 'data deficient'. It is possible to draw up a more complete list of species requiring attention, but it remains a subjective selection because the source data is so scanty (Table 2). The species listed can be regarded as future candidates for 'proper' listing in a Red Data Book. There are numerous species in gomphid genera (e.g. *Neurogomphus*, *Notogomphus*, *Paragomphus* and *Tragomomphus*) and the corduliid genus *Phyllomacromia* that may need to be included, but their taxonomy is too problematic at present to make a sensible selection. Because Gomphidae and Corduliidae are also difficult to record, no species from these families are listed in Table 2. The bottom-line is that more research in the field and in the museum is needed.

Table 2: Odonata species of western Africa requiring special attention.

Family/species	Known distribution and suspected habitat
Calopterygidae	
<i>Sapho fumosa</i> Longfield, 1932 ¹	Forest streams (mostly highland) Guinea-Bissau to Côte d'Ivoire
<i>Umma mesumbei</i> Vick, 1996	Mountain forest streams and seepage Mt. Kupe and at several sites in the Bakossi mountains, Cameroon
<i>puella</i> Sjöstedt, 1917	Forested lowland streams Takamanda, Cameroon
<i>purpurea</i> Pinhey, 1961	Forested lowland streams Bioko and Takamanda, Cameroon
Amphipterygidae	
<i>Pentaplebia gamblesi</i> Parr, 1977	Mountain forest streams Obudu, Nigeria
<i>stahli</i> Förster, 1909	Mountain forest streams Cameroon and Nigeria
Chlorocyphidae	
<i>Chlorocypha neptunus</i> (Sjöstedt, 1900)	Forested lowland streams Cameroon
Megapodagrionidae	
<i>Neurolestes trinervis</i> Selys, 1885	Mountain forest streams Cameroon, Nigeria and Gabon
<i>Nesolestes nigeriensis</i> Gambles, 1970	Mountain forest streams Cameroon and Nigeria
Perilestidae	
<i>Nubiolestes diotima</i> (Schmidt, 1943)	Mountain forest streams Cameroon
Coenagrionidae	
<i>Agriocnemis angustirami</i> Pinhey, 1974	Coastal sites Sierra Leone and Liberia
<i>Azuragrion buchholzi</i> (Pinhey, 1971)	Lakes Bioko and SW Cameroon
<i>Ceriagrion citrinum</i> Campion, 1941	Forested rivers Benin and W Nigeria
<i>ignitum</i> Campion, 1941	Aburi, Ghana
<i>tricrenaticeps</i> Legrand, 1984	Liberia, Gabon and NE Congo-Kinshasa
<i>Pseudagrion aguessei</i> Pinhey, 1964	Streams in open landscape Sierra Leone, Mali and Benin
<i>cyathiforme</i> Pinhey, 1973	Small forest rivers Sierra Leone, Liberia and Nigeria
<i>emarginatum</i> Karsch, 1893	Streams in the forest-savannah transition from Ghana to NE Congo-Kinshasa
<i>malagasoides</i> Pinhey, 1973	Small forest rivers from Liberia to Nigeria
Platycnemididae	
<i>Mesocnemis dupuyi</i> Legrand, 1982	Savannah rivers Senegal
<i>tisi</i> Lempert, 1992	Shaded sections of forest rivers Liberia
<i>Platycnemis escherichi</i> Schmidt, 1951	Cameroon and Nigeria
<i>rufipes</i> (Selys, 1886)	Cameroon and Nigeria
<i>Stenocnemis pachystigma</i> (Selys, 1886)	Mountain forest streams and seepages Cameroon, old records west to Sierra Leone must be verified. Possibly breeds in water-film dripping over rocks (Vick 1998).
Protoneuridae	
<i>Chlorocnemis eisentrauti</i> Pinhey, 1974	Dikume, Cameroon
<i>Elatoneura dorsalis</i> Kimmins, 1938	Sierra Leone
<i>pluotae</i> Legrand, 1982	Shaded streams SE Senegal

¹ We include *Umma informosa* Fraser, 1951 here, but see Legrand (2003)

Family/species**Known distribution and suspected habitat****Libellulidae**

<i>Mesumbethemis takamandensis</i> Vick, 2000	Lowland forest Takamanda, Cameroon
<i>Neodythemis gorillae</i> Pinhey, 1961	Mountain forest streams Cameroon and Nigeria
<i>scalarum</i> Pinhey, 1964	Forest Sierra Leone
<i>Olpogastra fraseri</i> Pinhey, 1956	Savannah rivers Uganda and Ghana
<i>Sleuthemis diplacoides</i> Fraser, 1951	Forest Sierra Leone and Guinea
<i>Trithemis hartwigi</i> Pinhey, 1970	Marsh and montane lake, Bioko and Cameroon
<i>Zygonychidium gracile</i> Lindley, 1970	Large savannah river (Bandama) near Korhogo, Côte d'Ivoire
<i>Zygonyx geminunca</i> Legrand, 1997	Forested rivers Guinea and Ghana

CRITICAL SITES AND THREATS**Forest**

Obviously forests form the primary sites of odonate diversity in western Africa (although the more open habitats should not be discounted, see below) and therefore deforestation poses the greatest threat. As in all parts of Africa, forests are relatively underrepresented in protected areas, as compared with savannah habitats. Nonetheless important nations like Liberia, Côte d'Ivoire, Ghana, Nigeria and Cameroon all have national parks in rainforest. The same is true for the countries of Central Africa. Unlike for instance big mammals, Odonata are not poached, do not require much space and are not easily disturbed. Therefore it may be expected that if natural islands in cultivated seas are properly protected, most species of Odonata are relatively safe. These islands must be strategically located, i.e. include a full range of forest types in sufficiently large and pristine form. In this respect the Cameroon highlands (see below) and the lowland centres of endemism in the Upper and Lower Guinea require special mention. Swamp forest, though poorly known, is also likely to be of a particular importance to odonate diversity.

Cameroon

The greatest priority for the conservation of Odonata in western Africa lies in Cameroon and the adjacent parts of Nigeria, Equatorial Guinea and Gabon. Both the highland and lowland rainforests here have a odonate diversity that is unrivalled in Africa. This diversity seems to be especially high in the South-West Province of Cameroon, a mountainous region adjacent to the Nigerian border, and recent work suggests very high species densities which are as high as those in the richest areas of tropical Asia and South America (Vick 1999). However, this region also stands out from other species-rich parts of West Africa in terms of the number of phylogenetically interesting taxa present. The notes below refer to the South-West Province.

There are relict genera with tropical American affinities: *Pentaphebia* belongs to a subfamily, Rimanellinae, of only three extant species, two in the Cameroon and Nigeria border region and one in the Guyana Highlands. The larvae are adapted to cling to the undersides of boulders in cold torrential streams. *Nubiolestes diotima* is the only African genus and species of a small family, Perilestidae, which is otherwise neo-tropical (Vick 1998). Also relict genera with other, or unclear, affinities occur: *Nesolestes* and *Neurolestes* are megapodagrionids which provide a link with the fauna of Madagascar. *Stenocnemis pachystigma* is a platycnemidid not closely related to any other taxon. The region is a diversity hotspot for the Calopterygidae and the Tetrathemistinae, a plesiomorphic subfamily of the worldwide Libellulidae. Twelve of the 18 species of the calopterygid genera *Phaon*, *Sapho* and *Umma* are present in the South-West Province, most of them specialists of rainforest streams. The Tetrathemistinae are believed to be close to the origin of their family and are almost entirely confined to streams and ephemeral pools in dense rainforest. Although probably a polyphyletic basal group, the subfamily is of great evolutionary interest. Some species oviposit epiphytically above the water surface. The recent discovery of the unique tetrathemistine *Mesumbethemis takamandensis*, in the Takamanda Forest north of Mamfe illustrates the potential of this region (Vick 2000).

Owing to the excellent quality of forest on Mount Kupe and its outstanding biodiversity (based on data for birds and plants), a conservation project was set up by BirdLife International (UK) in 1991 – the Mount Kupe Forest Project. Evidence from the surveying carried out by the Cameroon Dragonfly Project since 1995 suggests that this is similarly a site of major importance for Odonata (Vick 1996, 1999) and a very high proportion of the endemic montane taxa of the region breed in its cool streams. Another area which appears to be of major importance for odonate diversity lies to the north of Mamfe and the Cross River: the contiguous region of the Takamanda-Mawne Forest Reserves (Cameroon) and the Okwangwo Division of the Cross River National Park (Nigeria). This huge area of about 1,700 km² forms a mosaic of lowland and highland moist forest with savannah woodland. Surveying is in an early stage in this region and has only been carried out on the Cameroon side, but first indications are of a rich fauna, which is distinct from that further south in the Province (Vick 2003).

Savannah

The larger part of western Africa is not forested, but is dominated by open and half-open landscapes, that gradually become drier towards the Sahara. This gradient includes broad belts of wooded savannah, and mosaics of forest and savannah (White 1983). These habitats harbour rich and distinct faunas, of which the study of Lindley (1974) in northern Côte d'Ivoire is the finest illustration. Although species diversity is lower than in heavily forested habitats, rare and endemic species occur here too, Lindley's own discovery *Zygonychidium gracile* being the best example (Lindley 1970). Recent material from Benin and Ghana (leg. K.-D.B. Dijkstra, H.A. Olsvik and S.L. Tchibozo) has revealed new records of such species: *Ceriagrion citrinum*, *Pseudagrion aguessei*, *P. emarginatum*, *Lestinigomphus minutus* Gambles, 1968 and *Olpogastra fraseri*.

Why are they so seldom recorded? Their habitat would seem to be present continuously from Senegal to Uganda; the records of *P. emarginatum* and *O. fraseri* are indeed so widely scattered. The main reason is probably that savannah has been under-sampled, even more so than forest. The majority of the species occurring in this zone appear to be abundant and widespread, adapted to the temporary conditions that prevail here with the sharp change of seasons. The discussed species may differ in being restricted to rarer habitats, such as those with permanent running water or a certain degree of tree cover. Despite the apparent continuity of savannah habitat and the large ranges of most species occurring here, it is noteworthy that the Beninese localities of *C. citrinum* and *L. minutus* are confluent with the previously known range of these species, being confined to western Nigeria. Another species discovered in Ghana recently is *Zygonyx geminunca*. It was described as recently as 1997 from the Guinean part of Mount Nimba (Legrand 1997). Because of its locality and late discovery, it might be thought that this distinctive species is exclusive to this isolated highland, but the Ghana record is from a forested valley in a low-lying area in the forest-savannah transition. The examples illustrate the importance of these habitats for Odonata and the scientific attention they deserve. The rediscovery of the only endemic genus of Africa's northern savannah belt, *Zygonychidium*, would seem the first priority.

SUGGESTED MEASURES

The remarks by Clausnitzer (2004) on research and conservation are valid for Africa as a whole.

CURRENT ACTIVITIES

The Cameroon Dragonfly Project (CDP) was established in 1995 by Graham Vick and David Chelmick of UK and Otto Mesumbe of Cameroon. Philip Corbet is the president. It is the first long-term dragonfly project in tropical Africa and its aim is to increase knowledge about Odonata in Cameroon and thereby contribute towards their conservation. The initial concentration of effort has been in the South-West Province as this region appears to be the most important biodiversity hotspot. The objectives are to describe the fauna taxonomically and produce a species list; to produce a key to adults; to identify areas of greatest conservation importance; to describe the larvae and write larval keys (e.g. Chelmick 1999). Perhaps the most important of all is to gain the interest and cooperation of local people. One of the most significant problems with the recording of Odonata in tropical forests is that the adults on which the specific identity depends are extremely elusive, can be difficult to catch, and frequently have behaviour patterns which mean that they only visit water rarely. Larvae are surprisingly easy to find in the small streams and rainforest pools which the rarest species occupy. The breeding of larvae to adulthood therefore provides us with an unequivocal determination and is often the only way to build up data for larval keys.

Once these are produced it will be relatively easy for non-experts and para-taxonomists to improve odonate site databases. Breeding also provides records of species which are never seen as adults. The larval work has been one of the most productive aspects of the Project and it is an excellent way of involving local people. The CDP has also forged links with WWF, BirdLife International, and CRES (San Diego) and the Smithsonian Institution (Washington).

K.-D.B. Dijkstra is working on reviews of the odonate faunas of Ghana and Benin, in collaboration with H.A. Olsvik and S.L. Tchiboza respectively.

REFERENCES

- Brooks, S.J. & K.A. Jackson, 2001. The Odonata of Bioko, Republic of Equatorial Guinea, with the description of fan-shaped setae on early instar Libellulidae larvae. *Odonatologica* 30: 29-38.
- Carfi, S. & M. D'Andrea, 1994. Contribution to the knowledge of odonatological fauna in Sierra Leone, West Africa. *Problemi Attuali di Scienza e di Cultura* 267: 111-191.
- Carle, F.L., 1986. The classification, phylogeny and biogeography of the Gomphidae (Anisoptera). I. Classification. *Odonatologica* 15: 275-326.
- Chelmick, D.G., 1999. Larvae of the genus *Anax* in Africa (Anisoptera: Aeshnidae). *Odonatologica* 28: 209-218.
- Clausnitzer, V., 2004. Critical species of Odonata in eastern Africa. In: Clausnitzer, V. & R. Jödicke (eds) "Guardians of the watershed. Global status of dragonflies: critical species, threat and conservation". *International Journal of Odonatology* 7: 189-206.
- Dijkstra, K.-D.B., 2002. The identity of the West African zygopterans *Pseudagrion emarginatum* and *P. camerunense* (Odonata: Coenagrionidae). *International Journal of Odonatology* 5: 105-110.
- Dijkstra, K.-D.B., 2003a. Fooled by the double: *Brachythemis liberiensis* is *Parazyxomma flavicans*, with a note on the Zygommatini (Odonata: Libellulidae). *International Journal of Odonatology* 6: 17-21.
- Dijkstra, K.-D.B., 2003b. A review of the taxonomy of African Odonata: finding ways to better identification and biogeographic insight. *Proceedings of the first PHAON meeting on African Odonata. Cimbebasia* 18: 191-206.
- Gambles, R.M., 1980. Odonata. In: Medler, J.T. "Insects of Nigeria, checklist and bibliography". *Memoirs of the American Entomological Institute* 30: 24-28.
- Gambles, R.M., N.W. Moore, M. Hämäläinen & E.D.V. Prendergast, 1998. Dragonflies from The Gambia: an annotated list of records up to the end of 1980. *Odonatologica* 27: 25-44.
- IUCN, 2003. 2003 IUCN Red List of threatened species. <www.redlist.org/>.
- Kingdon, J., 1989. *Island Africa*. Princeton University Press, Princeton.
- Legrand, J., 1976. Rediscription de la larve de *Neophya rutherfordi* Selys, 1881 (Anisoptera: Corduliidae). *Odonatologica* 5: 277-284.
- Legrand, J., 1982. Contribution a l'étude des odonates de Lamto, Cote d'Ivoire. *Revue Française d'Entomologie (N.S.)* 4: 7-17.
- Legrand, J., 1983. Note sur les odonates actuellement connus des Monts Nimba (Afrique occidentale). *Revue Française d'Entomologie (N.S.)* 5: 152-162.
- Legrand, J., 1984. Un deuxième *Idomacromia* de la forêt Gabonaise: *I. lieftincki* spec. nov. (Anisoptera: Corduliidae). *Odonatologica* 13: 113-117.

- Legrand, J., 1996. La larve de *Idomacromia proavita* Karsch, 1896 (Odonata, Anisoptera, Corduliidae). Revue Française d'Entomologie (N.S.) 18: 134.
- Legrand, J., 1997. *Zygonyx geminunca* n. sp. nouveau Zygonychinae des Monts Nimba Afrique Occidentale (Odonata, Anisoptera, Libellulidae). Revue Française d'Entomologie (N.S.) 19: 73-76.
- Legrand, J., 2003. Les Odonates du Nimba et de sa region. Memoires du Museum National d'Histoire Naturelle 190: 231-310.
- Legrand, J. & G. Couturier, 1985. Les Odonates de la foret de Tai (Côte d'Ivoire). Premieres approches: faunistique, repartition ecologique et association d'especies. Revue d'Hydrobiologie Tropicale 18: 133-158.
- Legrand, J. & C. Girard, 1992. Biodiversité des odonates du Simandou, recensement des espèces de Guinee, Afrique occidentale (Odonata). Opuscula Zoologica Fluminensia 92: 1-23.
- Lempert, J., 1988. Untersuchungen zur Fauna, Ökologie und zum Fortpflanzungsverhalten von Libellen (Odonata) an Gewässern des tropischen Regenwaldes in Liberia, Westafrika. Diplomarbeit, Universität Bonn.
- Lindley, R.P., 1970. On a new genus and species of libellulid dragonfly from the Ivory Coast. The Entomologist 103: 77-83.
- Lindley, R.P., 1974. The dragonflies of Korhogo, Ivory Coast. Bulletin de l'Institut Fondamental de l'Afrique Noire (A) 36: 682-698.
- Moore, N.W., 1997. Dragonflies – status survey and conservation action plan. IUCN/SSC Odonata Specialist Group. IUCN, Gland & Cambridge.
- O'Neill, G. & D.R. Paulson, 2001. An annotated list of Odonata collected in Ghana in 1997, a checklist of Ghana Odonata, and comments on West African odonate biodiversity and biogeography. Odonatologica 30: 67-86.
- Pinhey, E., 1982. Preliminary list of little known or vanishing Afrotropical Odonata. Reports of the Odonata Specialist Group International Union for Conservation of Nature 2: 4 pp.
- Prendergast, E.D.V., 1998. The Gambia: additions to the list of Odonata, and further distribution records. International Journal of Odonatology 1: 165-174.
- Vick, G.S., 1996. *Umma mesumbei* spec. nov., with records of some other dragonfly species from the South-West province of Cameroon (Zygoptera: Calopterygidae). Odonatologica 25: 167-178.
- Vick, G.S., 1998. Notes on some damselfly larvae from Cameroon (Zygoptera: Perilestidae, Amphipterygidae, Platycnemididae). Odonatologica 27: 87-98.
- Vick, G.S., 1999. A checklist of the dragonflies of the South West province of Cameroon, with a description of *Phyllogomphus corbeti* spec. nov. (Anisoptera: Gomphidae). Odonatologica 28: 219-256.
- Vick, G.S., 2000. *Mesumbethemis takamandensis* gen. nov., spec. nov., a new genus and species of the Tetrathemistinae from Cameroon, with a key to the African genera of the subfamily (Anisoptera: Libellulidae). Odonatologica 29: 225-237.
- Vick, G.S., 2003. Biodiversity assessment of the odonate fauna of Takamanda Forest Reserve, Cameroon. In: Comiskey, J.A., T.C.H. Sutherland & J.L. Sutherland-Groves (eds) "Takamanda: the biodiversity of an African rainforest", Smithsonian Institute, USA.
- White, F., 1983. Vegetation of Africa – a descriptive memoir to accompany the Unesco/AETFAT/UNSO vegetation map of Africa. Natural Resources Research Report XX. U.N. Educational, Scientific and Cultural Organization, Paris.